CLAIMS

1. An optical path length adjuster (53, 53a, 53b, 100) for varying an optical path length between an input optical path (52) and an output optical path (54, 74), comprising:

a first polarisation switch (60) for selecting a polarisation state for an input beam on the input optical path (52); and

first and second beam splitters (61, 62, 105, 106) having at least two possible optical paths (63, 64, 110, 111, 112) of different lengths therebetween, for passing the input beam along a selected one of said at least two possible optical paths according to the selected polarisation state of the input beam and for providing an output beam of light, on said optical output path (54, 74), that has travelled along the selected optical path.

2. The apparatus of claim 1 in which a first one of said possible optical paths (63, 110) extends directly between a first output surface (61b, 105b) of the first beam splitter (61, 105) and a first input surface (62a, 106a) of the second beam splitter (62, 106), and a second one of said possible optical paths (64, 111) extends between a second output surface (61c, 105c) of the first beam splitter (61, 105) and a second input surface (62b, 106b) of the second beam splitter (62, 106), via additional optical elements (66a, 66b, 108a, 108b).

3. The apparatus of claim 2 in which the additional optical elements include mirrors (66a, 66b, 108a, 108b).

4. The apparatus of claim 2 or claim 3 in which the second optical path (64, 111) includes at least two path segments (64a, 64c) that are transverse to the input path (52).

5. The apparatus of claim 4 in which the second optical path (64, 111) includes at least two path segments (64a, 64c) that are orthogonal to the input path (52).

6. The apparatus of any preceding claim in which at least one of the possible optical paths (63, 64) includes a focusing element (90, 91) therein.

7. The apparatus of claim 6 in which all of the possible optical paths (63, 64) include a focusing element (90, 91) therein.

8. The apparatus of claim 6 or claim 7 in which the focusing elements include lens elements (90, 91) each adapted to constrain an image dimension being transmitted along the respective optical path (63, 64) to fit within the optics of the associated beam splitter (61, 62).

9. The apparatus (53a) of any preceding claim combined with at least one further optical path length adjuster (53b) of any preceding claim in a cascade formation, such that the output optical path (54) of the first said optical path length adjuster (53a) forms the input path (72) of a successive said further optical path length adjuster (53b).

10. The apparatus of claim 9 in which the second optical paths (64, 84, 111) of each said optical path length adjuster (53, 100) include different optical path lengths such that a plurality of possible overall optical path lengths are selectable by appropriate selection of path length within each said optical path length adjuster.

11. The apparatus of any preceding claim in which at least some of the possible optical paths (110, 111, 112) include a further polarisation switch (104, 102, 103) therein, each further polarisation switch operative to select a subsequent possible optical path (110, 111, 112) or the output optical path (54).

12. The apparatus of claim 11 in which:

the first beam splitter (105) has a first optical input (105a) coupled to the optical output of the first polarisation switch (101), for diverting light at the optical input of the first splitter to first and second optical outputs (105b, 105c) respectively according to a polarisation state of the light at the optical input of the first splitter;

the second beam splitter (106) has first and second optical inputs (106a, 106b) respectively optically coupled to the first and second outputs (105b, 105c) of the first beam splitter (105), via respective said first and second optical paths (110, 111), the second beam splitter (106) diverting light at the first and second inputs (106a, 106b) to first and second outputs (106c, 106d) of the second beam splitter (106) according to a polarisation state of light at the first and second inputs thereof;

the first output (106c) of the second beam splitter (106) defines the optical output path (54), and the second output (106d) of the second beam splitter is optically coupled to a second input (105d) of the first beam splitter (105) via a third optical path (112);

each of the first, second and third optical paths (110, 111, 112) respectively includes one of a second, a third and a fourth polarisation switch (104, 102, 103),

the first, second, third and fourth polarisation switches adapted to thereby select cumulative combinations of one or more of said first, second, and third optical paths between the input optical path (52) and the output optical path (54).

13. A display device for generating a three-dimensional volumetric image, comprising:

a two-dimensional image display panel (41, 46) for generating a two-dimensional image;

a first focusing element (42, 47) for projecting the two-dimensional image to a virtual image (40, 45) in an imaging volume (44, 49); and

means (43, 48, 53, 53a, 53b, 100) for altering the effective optical path length between the display panel and the projecting first focusing element so as to alter the position of the virtual image within the imaging volume, wherein the means for altering the effective optical path length comprises the optical path length adjuster according to any one of claims 1 to 12.

14. A method for varying an optical path length between an input optical path (52) and an output optical path (54, 74) of an optical path length adjuster (53, 53a, 53b, 100), comprising the steps of:

selecting a polarisation state for an input beam of light on the input optical path using a first polarisation switch (60);

passing the input beam into a first beam splitter (61, 105) and along a selected one of at least two possible optical paths (63, 64, 110, 111) of different lengths according to the selected polarisation state of the input beam, the at least two possible optical paths extending between the first and a second beam splitter (62, 106); and

providing an output beam of light, from the second beam splitter, on said optical output path (54).

15. The method of claim 14 further including the step of causing the light to traverse a plurality of additional optical elements (66a, 66b, 108a, 108b) on the second one of said possible optical paths (64, 111) when the second optical path is selected.

16. The method of claim 15 in which the plurality of additional optical elements traversed include mirrors (66a, 66b, 108a, 108b).

17. The method of claim 15 or claim 16 in which the light on said second optical path (64, 111) traverses at least two path segments (64a, 64c) that are transverse to the input path.

18. The method of claim 17 in which the light on said second optical path (64, 111) traverses at least two path segments (64a, 64c) that are orthogonal to the input path.

19. The method of any one of claims 14 to 18 further including the step of passing the light on at least one of the possible optical paths through a focusing element (90, 91) therein.

20. The method of claim 19 further including the step of passing the light on all of the possible optical paths through a focusing element (90, 91) therein.

21. The method of claim 19 or claim 20 further including adapting the focusing elements to constrain an image dimension being transmitted along the respective optical path to fit within the optics of the associated beam splitter (62, 105, 106).

22. The apparatus of any one of claims 14 to 21 further including passing light from the output path (54) to an input path (72) of a downstream optical path length adjuster (53b) and repeating the steps for adjusting the optical path length.

23. The method of claim 22 further including the step of selecting different optical path lengths within each said optical path length adjuster (53a, 53b).

24. The method of any one of claims 14 to 23 further including the step of selecting a subsequent optical path by way of a further polarisation switch (102, 103, 104) within a selected optical path.

25. The method of claim 24 further including the step of selecting cumulative combinations of one or more of first, second, and third optical paths

(110, 111, 112) between the first and second beam splitters (105, 106) using a polarisation switch (102, 103, 104) within each of said first, second and third optical paths.

26. A method for generating a three-dimensional volumetric image, comprising the steps of:

generating a two-dimensional image on a two-dimensional image display panel (41, 46);

projecting the two-dimensional image to a virtual image (40, 45) in an imaging volume (44, 49) with a first focusing element (42, 47); and

altering the optical path length between the display panel and the projecting focusing element so as to vary the position of the virtual image within the imaging volume according to the method of any one of claims 14 to 25.